Spacecraft ram glow and surface temperature

G. R. Swenson and S. B. Mende (Both at: Lockheed Palo Alto Research Laboratory, D91-20/B255, 3251 Hanover Street, Palo Alto, Ca. 94304)
E. J. Llewellyn (ISAS, University of Saskatchewan, Saskatoon, Canada)

Space shuttle glow intensity measurements show large differences when the data from different missions are compared. In particular on the 41-G mission the Space Shuttle ram glow was observed to display an unusually low intensity. Subsequent investigation of this measurement and earlier measurements suggest that there was a significant difference in temperature of the glow producing ram surfaces. The highly insulating properties coupled with the high emissivity, of the shuttle tile results in surfaces that cool quickly when exposed to deep space on the night side of the orbit.

The increased glow intensity is consistent with the hypothesis that the glow is emitted fromm excited NO_2. The excited NO_2 is likely formed through three body recombination ($OI + NO + M = NO_2^*$) where ramming OI interacts with weakly surface bound NO. The NO is formed from atmospheric OI and NI which is scavenged by the spacecraft moving through the atmosphere. We postulate that the colder surfaces retain a -thicker- layer of NO thereby increasing the probability of the reaction. It has been found from the glow intensity/temperature data that the bond energy of the surface bound precursor, leading to the chemical recombination producing the glow, is ~0.14 ev. A thermal analysis of material samples of STS-8 has been made and the postulated temperature change of individual material samples prior to the time of glow measurements above respective samples are consistent with the thermal effect on glow found for the orbiter surface.